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splitting racemic compounds, to the three already known, the mechanical, the bio-chemical and the physical.

J. L. H.

LIMITATIONS OF THERMODYNAMICS.

AN important paper has recently been issued from the press of Dunod as a reprint from the *Revue de Mécanique*, current volume, in which M. Georges Duchesne presents the results of a very extensive experimental study of the thermal and thermodynamic processes in operation in the steam engine and especially during the period of emission, which has been the most difficult of investigation and the most obscure of all the elements of the vapor-engine cycle.*

With a vapor engine in steady operation the observation of the amount of liquid passing through the system in the unit of time gives the measure of the quantity taken into the working cylinder at each stroke of its piston, and this, with the determination of 'quality' by the 'calorimeter,' and automatic registration of volumes and pressures, by the 'indicator' of Watt, permits the exact apportionment of energies and the physical condition of the fluid to be determined from the instant of closure of the induction-valve to its opening at the commencement of exhaust. The delineation of the 'saturation-curve' on the indicator-diagram, for the quantity of fluid known to have entered the cylinder, gives the measure of contemporaneous volumes of the corresponding quantity of 'dry and saturated' vapor which serves as the unit of the scale measurements of the relative volumes, and weights of liquid and vapor in the mixture constituting the working fluid, or the extent of superheating, if at any point superheated. From the instant of commencement of emission, however, no measure is obtainable of these quantities, and the problem becomes incapable of solution by ordinary observation.

Donkin has sought the solution of this particular question of the state of the vapor in the period of emission and that of compression by the use of his 'revealer,' by means of which the

fluid is sampled and tested as to quality, and Professor Carpenter, in the laboratories of Sibley College, has sought the same end by the use of the now familiar 'steam-calorimeter,' taking off samples of the steam automatically at certain points in the portion of the cycle to be investigated. Donkin concluded that the vapor in the exhaust period was wet; Hirn, Carpenter and others, including Dwelshauvers-Dery, have found it dry. M. Duchesne revises the work of Donkin, particularly, and concludes that, contrary to the deduction of the investigator himself, the research indicates that the vapor is dry and saturated during the period of emission. He decides that the results of those experiments furnish 'proof of the complete dryness of the surface at the end of emission.' If dry at this point, they will presumably continue dry up to the beginning of the period of compression, and, then, mechanical compressions alone affecting the fluid, superheating should occur. This was the conclusion of the writer long before the apparatus and method of recent research was ready to give its testimony in the case,* as respects economically operated engines; but the contrary as regards uneconomical engines, in which the working fluid, after entering the cylinder, is very wet, and Willans based upon the same conviction the details of design in his engine insuring that the moisture deposited upon the cylinder-walls should be swept off as thoroughly as possible by the current of the working fluid. M. Duchesne finds confirmation of these anticipations in the work of Hirn, of Delafond and of Dwelshauvers-Dery; the latter affording him very conclusive evidence, which he reviews at length.

The conclusions reached are the following, in substance :

(1) When, in the engine-cylinder, the vapor is saturated and the walls humid, the vapor and the water on the surface of the metal in immediate contact with the liquid assume almost instantaneously the same temperature.

(2) If the surface is dry, it may take a temperature superior to that of the fluid.

* L'État de la Vapeur a la Fin de l'Émission ; par Georges Duchesne, Ingénieur, ancien Assistant du Professeur V. Dwelshauvers-Déry ; Paris, Vve. Ch. Dunod, 1899. Royal 8vo., pp. 15.

* Manual of the Steam-Engine, Vol. I., § 53, pp. 355-627, especially p. 631. Trans. A. S. M. E., 1890, No. CCCLXII. ; 1894, No. DLXVI. ; 1894, 1896, pp. 843, etc.

It is to be remembered that the nearer the fluid to the state of saturation, the more readily does it surrender heat.

In the indicator-diagram it is often observed that there exists a point of inflexion at the summit of the compression-curve. This has been, by earlier authorities, generally ascribed to leakage past the piston on attaining a certain limiting pressure at which the piston-rings yield. Later observers have suspected and the writer has long believed that this peculiar inflexion may mark a point at which the surrender of heat of compression to the metal of the cylinder-wall occurs so rapidly, as a consequence of the increasing temperature-head, as to cause more rapid condensation than can be counteracted in its effect upon pressure by the constantly diminishing rate of compression. This phenomenon, in such case, is an indication, if not a measure, of the heat-exchange thus taking place. M. Duchesne finds confirmation in his own experiments of this later idea, and of the propositions which he has advanced, as well as of the accuracy of the work of M. Dwelshauvers-Dery.

R. H. THURSTON.

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SCIENTIFIC NOTES AND NEWS.

THE National Academy of Sciences will hold its annual fall meeting at Columbia University, New York, from November 14th to 17th.

PROFESSOR DEAN C. WORCESTER, of the University of Michigan, has returned to the United States, to report to the President as one of the members of the Philippine Commission.

PROFESSOR GEORGE T. LADD, of Yale University, who is at present in Japan, has received from the Japanese Emperor, the third-class decoration of the Order of the Rising Sun.

DR. EUGENE A. DARLING has been appointed bacteriologist of the Cambridge Board of Health, to succeed Dr. George B. Henshaw.

MR. W. H. TWELVETREES, F.G.S., has recently been appointed to the position of geologist to the Government of Tasmania.

DR. ALFRED JENTZSCH, docent at Königsberg, has been appointed geologist of the Government Survey in Berlin.

DR. OTTO LUBARSCH, associate professor at Rostock, has been made director of the pathological and anatomical division of the newly established State Institute of Hygiene at Posen.

MR. J. E. DUERDIN, curator of the Kingston Museum, Jamaica, is this year studying at the Johns Hopkins University.

MR. W. H. M. CHRISTIE, C.B., the Astronomer Royal has been elected one of the Wardens of the Clockmakers' Company.

DR. LOUIS L. SEAMAN offers, through the Military Service Institution of the United States, a prize of \$100 for the best essay on 'The Ideal Ration for an Army in the Tropics.' Papers should be received before March 1, 1900.

MR. HAMILTON Y. CASTNER, died at Saranac Lake, N. Y., on October 10th, aged 41 years. Mr. Castner made important advances in industrial chemistry, especially in the manufacture of aluminium and in the electrolytic processes of manufacturing caustic soda and chlorine from chloride of sodium.

THE death is announced at Obersdorf of Dr. Ernst Rosenberger, known for his writings on the history of physics.

DR. KARL RUSS, the ornithologist, died at Berlin on September 29th, aged 66 years.

It has been proposed to place a bust and an enlarged photograph of the late Dr. Friedel in the hall of the Sorbonne. The estimated cost of the bust, which will be the work of M. Uitain, is 3,000 francs. An appeal for subscriptions has been issued. These should be sent to M. Chason, at the Laboratory of Organic Chemistry, Faculty of Science, the Sorbonne.

At the ceremonies attending the unveiling of the monument of Johannes Müller at his birth-place, Coblenz, on October 2d, Professor Virchow was the principal speaker. The *British Medical Journal* states that in the course of his address Professor Virchow referred to the difficulty that had been found in choosing an appropriate inscription. The simple one chosen by the sculptor: 'To the great anatomist and physiologist,' would perhaps hardly satisfy all concerned. Strictly speaking, Johannes Müller was a biologist, a naturalist whose aim